

IX.—*On the Voles (Arvicola) of the Himalayas, Tibet, and Afghanistan.*
—By W. T. BLANFORD, F. R. S, &c.

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(With Plates I and II.)

Within the last few years several species of *Arvicola* have been described from the Himalayas and from the country north of the range ; and quite recently two additional forms have been procured from the same region, and two others have been found in the collection of the East-India Museum—one from the Himalayas, the other from Afghanistan. I propose in the present paper to give an account of all the Himalayan, Tibetan, and Afghan Voles hitherto described, so far as I am acquainted with them. I also propose to describe and figure the molar dentition of all available forms. I may add that I have had the advantage of examining the original specimens of all the species described.

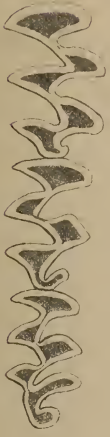
There is much reason to doubt whether any kind of *Arvicola* has hitherto been described within the limits of the Oriental Region proper*, the forms occurring on the Himalayas being found at an elevation where there is either an intermingling of Oriental and Palæartic types, or where the latter prevail—the rodents, undoubtedly obtained from the plains of India, that have been referred to the genus *Arvicola* being really true Murinæ, without the peculiar dental organization of the Voles. Such is especially the case with *Arvicola bengalensis* and *A. indica* of Gray and Hardwicke's 'Illustrations of Indian Zoology,' both of these forms having been shown to belong to the Murine genus or subgenus *Nesokia*†.

The earliest description of a Himalayan *Arvicola*, so far as I am aware, was that of *A. roylei*, by Dr. Gray‡, 1842. The same animal was

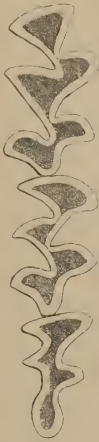
* In Blyth's 'Catalogue of the Mammalia in the Museum of the Asiatic Society,' Calcutta, a stuffed skin of *Arvicola roylei* is included, and said to have been obtained from Pind Dádun Khán, in the Punjab. This specimen was presented by Mr. Theobald in 1853, according to the catalogue ; but it is remarkable that no reference is given, and that the species is not mentioned in either of the two lists of specimens from Pind Dádun Khán and other places presented to the Society's Museum by Mr. Theobald in 1853 (J. A. S. B. 1853, xxii. pp. 410, 580). The specimen could not be found lately, when a search was made for it at my request. I have no hesitation in considering that either the identification or the locality is open to grave question, and in rejecting the evidence as for the present in need of confirmation.

† Blyth. J. A. S. B. 1863, xxxii. p. 328 ; Anderson, J. A. S. B. 1878, xlvii. pt. 2, pp. 214, 221, 227.

‡ For references see synonymy of species.



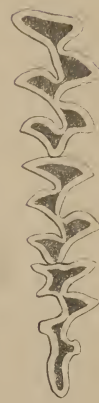
A



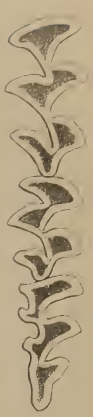
B



C



D



E



Edwin Wilson, del et lith.

Martens Bros. imp.

A. *Arvicola sikkimensis*.

B. *A. wynei*.

E. *A. blanfordi*

C. *A. stracheyi*.

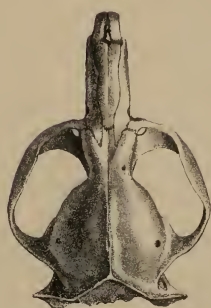
D. *A. roylei*.



A.



B.



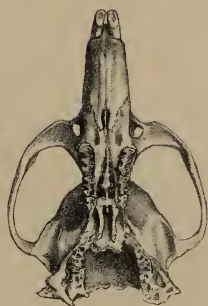
D^a.



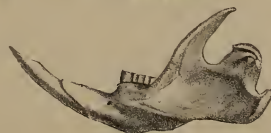
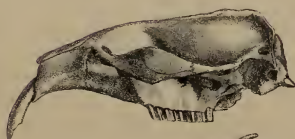
D.



C.



D^b.



Edwin Wilson del et lith.

Mintern Bros. imp.

A. *Arvicola melanogaster*.

B. *A. blythi*.

C. *A. mandarinus*.

D. *Ellobius fuscicapillus*.

mentioned at p. lxxviii of the "Memoir on the Mammalogy of the Himalayas," by W. Ogilby, published as an appendix in Royle's 'Illustrations of the Botany &c. of the Himalayas,' and the dried skin was said to be undistinguishable from that of *A. arvalis*. In the same memoir, on the preceding page (lxvii), another short-tailed rodent is said to have been observed by Hodgson and Herbert, and supposed to be a Lemming. The animals noticed were doubtless *Arvicolæ*, no Lemming having ever been found as yet in the Himalayan area. The original specimen of *A. roylei* has been preserved in the British Museum, and was originally procured by Royle, it is said from Kashmir.

The next notice in order of date was by Mr. Hodgson, who, in 1849, recorded the occurrence of an Arvicoline animal in Sikkim. For this form, which he considered the type of a new genus, he proposed the name *Neodon sikimensis*. As will be shown presently, the genus cannot be maintained as distinct from *Arvicola*, although it forms a well-marked section, distinguished by its dentition. In 1863 Mr. Blyth proposed a third genus *Phaiomys*, for a species, which he named *Ph. leucurus*, brought by Mr. Theobald from the banks of the Tsomoriri, in Western Tibet. The reasons assigned for the establishment of the genus, namely, that the Tibetan form is more robust and has a well-developed thumb and nail to the fore foot, appear to have been suggested by comparison of an abnormally large individual with but one or two species of *Arvicola*, since many Voles are equally robust, and numerous species possess a well-marked thumb furnished with a nail*. The specific name also, having been preoccupied, has been changed to *A. blythi*.

The three species thus described were all enumerated in Blyth's 'Catalogue of the Mammalia in the Museum Asiatic Society,' published in 1863, and two of them were described in Jerdon's 'Mammals of India.' The third species, *Phaiomys leucurus*, was noticed only, not described, as the trans-Himalayan region was not comprised in the countries the animals of which were included by Jerdon in his fauna. No further addition was made to the number of Arvicoline animals from the Himalayas for some years, until, in 1872, A. Milne-Edwards described a new species, *A. melanogaster*, brought by Père David from the eastern portion of the Himalayan

* See 'Scientific Results of the Second Yarkand Mission,' Mammalia, pp. 39—43. There are three serious misprints on p. 39. The first, 15 lines from the bottom, consists of the omission of the words "of the thumb" after "ungual phalanx." The second is in the measurements: "Do. of fore foot and claws" should be "Length of fore foot" &c.; as it stands it appears to be the breadth. The third is the worst of all: I wished to point out that if the genus *Phaiomys* be retained, the correct spelling is *Phaomys*. The printer has made nonsense of this by putting *Phaiomys* in both instances.

tract. Another form was procured by Dr. Stoliczka on his last journey, when attached to Sir D. Forsyth's mission to Eastern Turkestan. This Vole was described by myself, in 1875, as *A. stoliczkanus*. In 1878 I received from my friend Mr. A. B. Wynne, of the Geological Survey of India, a skin and skull of an *Arvicola* obtained by him at Mari or Murree, in the hills north of the Punjab. On comparing this specimen with the description of *Arvicola roylei*, I found considerable similarity but there appeared to be a difference in the characters of the posterior upper molar teeth. This distinction alone, however, I thought insufficient without further comparison; and I therefore waited until I returned to England last year, when I compared the Murree animal (of which, in the meantime, Mr. Wynne had procured for me additional specimens) with the type of *A. roylei*, and ascertained that the two were distinct. At the same time Mr. Thomas found an example of another species from Kumaon in the specimens of the East-India Company's Museum, which had just been made over to the British Museum; and Dr. Scully brought several skins and spirit-specimens of yet another form from Gilgit. All these forms appeared to be undescribed. One more skin in the East-India Company's collection, procured by Griffith in Afghanistan, and hitherto supposed to be an imperfect specimen of *Mus mettada*, proved, on the skull being extracted, to be an *Arvicola*. There does not seem to be any definite character by which, judging from dried skins, this form can be distinguished from the Mongolian *A. mandarinus*; and although it is by no means improbable that fresh specimens may show the existence of specific distinction, it does not appear advisable to propose a new name for the Afghan specimen on the evidence of a single dried skin.

All of these Voles are fairly distinguishable by their dentition, and all when placed together, can be recognized by slight differences of coloration, and frequently by the relative proportions of the ears, feet, toes, or tail; but in descriptions it is very difficult to explain small distinctions of colour due to different shades of brown more or less mixed with grey, black, red, or yellow.

As is well known, the genus *Arvicola* is distributed throughout nearly the whole of the Palearctic and Nearctic Regions, and comprises many species. The classification of these forms has proved a by no means easy problem, and various plans have been proposed; the best known and simplest of these appears to be that of Blasius*, some form of which has been adopted by most modern writers. This system depends chiefly on the

* München, Bull. Akad. 1853, col. 257; Münch. Gel. Anz. xxxvii. 1853, col. 105. Säugthiere Deutschlands, pp. 333—336 &c. The first sketch of the scheme was in Keyserling and Blasius 'Wirbelthiere Europa's (1840), p. 40.

characters of the molar teeth, and especially on the number of prisms, triangles, or spaces on the crowns, and the number of external and internal salient angles on the sides of each tooth. In estimating the number of prisms or spaces (Schmelzschlingen), those on different sides of the tooth are counted separately, unless they are exactly opposite to each other; whilst in estimating the salient angles, all that form a distinct fold on the outside of the tooth are enumerated, although, when the teeth are but little worn, such angles are not conspicuous on the crown. As in most other systems of biological definition, it is impossible to obtain absolute uniformity, since it is often a question whether the spaces on the crown of the tooth enclosed by angles on opposite sides correspond or alternate, and, consequently, whether they are to be counted as two or as one. An instance is afforded by the lower molar teeth of *A. sikimensis* (see Plate I. fig. A). In the first tooth it is difficult to say whether the number of spaces or prisms should be counted as 7, 8, or 9, the latter number, however, would best agree with the general practice; but in the hindmost lower molar we might by this plan count 5 prisms, whereas, in accordance with the usual plan, the number is but 3. To avoid this difficulty some writers enter into details on the construction of the separate teeth*, but this makes the description rather long.

In counting the external and internal angles also, it is difficult at times to say whether a mere convexity, that does not form a distinct angle, or a comparatively rudimentary fold, such as is frequently found in the anterior portion of the first lower molar, should be included or not; and there are sometimes individual variations within the limits of the same species. Good figures are the only safeguards against misunderstanding.

The European forms are thus divided by Blasius:—

I. *Molars furnished with roots in the adult animal.*

A. *HYPUDÆUS*, Illig.

First lower molar with 7 spaces, 4 outer and 5 inner angles; second lower molar with 3 divided spaces and 3 internal and external angles; second upper molar with 4 spaces, 3 outer and 2 inner angles. The interparietal bone throughout the whole breadth of its hinder margin raised in a flat convexity, a pointed projection in the middle of the bone in front, and a long gradually diminishing point on each side.

The European forms are *A. glareolus* and *A. rutilus*.

II. *Molars rootless.*

B. *PALUDICOLA*.

First lower molar with 7 spaces, 4 outer and 5 inner angles; second lower molar with 5 simple spaces and 3 internal and external angles; second

* For instance, Coues and Allen, 'Monograph of North-American Rodentia,' *Murida*, genus *Arvicola*.

upper molar with 4 spaces, 3 outer and 2 inner angles. Interparietal bone with the hinder edge raised in the middle, concave towards the sides, with a projecting point in the middle in front, obliquely truncated on the sides, and terminating in long points projecting outwards and backwards. Dorsal surface of body grey of various shades to brownish black.

This comprises *A. amphibius*, *A. nivalis*, *A. ratticeps*, and *A. brandti*.

C. AGRICOLA.

First lower molar with 9 spaces, 5 outer and 6 inner angles; second upper molar with 5 spaces, and 3 angles both inside and outside; second lower molar with 5 spaces and 3 angles on each side. The interparietal elevated into a flat convexity along the whole width of the hinder margin, produced into an angle in front, and cut off almost at a right angle at the sides. The dorsal surface of the body dark blackish, brownish grey.

The only European form is *A. agrestis*.

D. ARVICOLA.

First lower molar with 9 spaces, 5 outer and 6 inner angles; second upper molar with 4 spaces, 3 outer and 2 inner angles; second lower molar with 5 simple spaces and 3 angles, both outside and inside. Interparietal convexly swollen throughout the whole breadth of the hinder margin, produced in front into a middle point, attenuate at the sides and sharply truncate, with a short oblique pointed projection directed outwards and backwards. Dorsal surface grey of various shades.

This, the typical form, is again divided into:—the Long-eared Voles, *Arvicola*—with 8 mammæ (4 on the breast, 4 on the groin), the planta with 6 distinctly separate roundish tubercles, the ear projecting beyond the fur, and the eye rather large; and the Short-eared Voles, *Microtus*—with only 4 mammæ, all on the groin, the planta with 4 tubercles, ears concealed by the fur, and eye very small. The first comprises the European *A. campestris* and *A. arvalis* and several Asiatic species, such as *A. socialis*, *A. saxatilis*, and *A. gregalis*; the second *A. subterraneus* and *A. savii*.

The American species have been similarly classified by Baird* and Coues†. The only European section said to be represented in America is the *Hypudæus* of Keyserling and Blasius‡, for which, as it is not the original *Hypudæus* of Illiger§, Coues has proposed the name *Evotomys*. It appears probable that this name must be adopted for the section of

* Mammals of North America, pp. 509–553 (1857).

† Monograph of North-American Rodentia, pp. 152 &c. (1877).

‡ Wirbelthiere Europa's, p. 34.

§ Prod. Syst. Mam. Av. p. 87.

Arvicolæ with rooted molars in the adult state. By both Baird and Coues *Evotomys* and *Hypudæus* are classed as a distinct genus. The true *Arvicolæ* of North America are divided into four subgenera. As none of these are Himalayan, it is unnecessary to specify them more fully. One of these sections (*Hemiotomys* of Baird, *Myonomes* of Coues), like the European *Agricola* and the Himalayan *Neodon*, has 3 salient angles on the inside of the second upper molar; but it has a 7-spaced first lower molar with but 4 outer and 5 inner angles, instead of a 9-spaced tooth with 5 outer and 6 inner angles.

We may now return to the Himalayan and Tibetan forms. None, so far as I know, have rooted molars. I have not been able to examine all the species; but as there are no roots to the molars of *A. sikimensis*, *A. wynnei*, *A. blythi*, *A. blanfordi*, or *A. stracheyi*, I think it improbable that the allied forms should exhibit so remarkable a character. All but two *A. sikimensis* and *A. melanogaster*, have the first lower molar, as in Blasius's section *Paludicola* (and as in *Hypudæus* or *Evotomys*), with 7 prismatic spaces, and normally with 4 outer and 5 inner angles, a fifth more or less rudimentary outer angle in front being present in some forms. The second lower and the second upper molar have also the same structure as the corresponding teeth in European forms of *Paludicola*—the circumstance that in some forms there are but 3 double spaces in the second lower molar instead of 5 simple prisms being, in fact, of no structural importance since the difference depends on whether the angles on opposite sides of the tooth correspond or alternate; and there is every possible gradation between one condition and the other. The Himalayan species, with 7-spaced anterior lower molars, however, are divided into two groups by the structure of the hinder upper molar. In *A. stoliczkanus*, *A. stracheyi*, *A. roylei*, *A. blanfordi*, and *A. wynnei* this tooth terminates in a narrow elongate lobe, produced backwards in the direction of the row of teeth, and posteriorly destitute of salient angles; whilst in *A. blythi* and in *A. mandarinus* (?) the last upper molar terminates, as in *A. amphibius* and its allies, in a crescent or transverse lobe, with a well-marked internal salient angle. The latter two species appear to belong to the European section *Paludicola*; for the former I venture to propose a new section, *Alticola*, of which *A. stoliczkanus* may be considered the type. In this form and in the nearly allied *A. stracheyi* the structure of the last tooth is so peculiar that they certainly deserve distinction. There are two small external angles anteriorly and two posteriorly, the two pairs being separated by a deep sinus, and there are but two interior angles, both, however, much stronger than those on the outer side of the tooth. These two typical forms of *Alticola*, moreover, are well distinguished from the others by the absence of any claw to the thumb. Of the other three forms *A. wynnei* is distin-

guished by having on the upper molar two well-marked external and two equally strong internal angles on the front part of the tooth, and a third rounded external angle on the posterior lobe; whilst in *A. roylei* and *A. blanfordi* there is a nearer approach to the structure of *A. stoliczkanus*, but there are three internal angles on the last upper molar.

A. sikimensis and *A. melanogaster* differ from the other Himalayan forms, firstly by having a longer first lower molar with, normally, 9 spaces, though there are fewer in *A. melanogaster*, owing to some of the angles on opposite sides corresponding; secondly, in both the first and second upper molars having an additional internal angle posteriorly. In the characters of the first lower and second upper molars, *A. sikimensis* agrees with the European *A. agrestis*, the type of the subgenus *Agricola* of Blasius, and the second upper molar is similar to that in the American subgenus *Myonomes* of Coues (type *A. riparius*), of which the first lower molar has but 7 prismatic spaces; but the first upper molar in *A. sikimensis* is different from that in any known European or American form, though, as will presently be noticed, there is a Western-Asiatic species with somewhat similar dentition. There can be but little doubt that the distinction was observed by Hodgson; it was noticed by Jerdon, and appears to have been the principal character upon which Hodgson's genus *Neodon* was founded. Another peculiarity of *A. sikimensis*, also mentioned by the same naturalists, is that the posterior lower molars are scarcely narrower than the preceding tooth. In most species of *Arvicola* there is a much greater diminution in the breadth of the lower molars posteriorly.

Although I fully admit the value of the distinction, I fail to see that the presence of this additional angle in the first upper molar of *A. sikimensis* proves that that species is generically distinct from *A. agrestis* (*Agricola*). The difference appears to me of the same value* as that between *A. agrestis*, for instance, and *A. arvalis*; that is to say, the distinction is merely sectional or subgeneric. I consequently consider *Neodon* a section or subgenus of *Arvicola*.

The species from Moupin, in Eastern Tibet, called *A. melanogaster* by A. Milne-Edwards, has a somewhat peculiar dentition owing to so many

* In the 'Scientific Results of the Second Yarkand Mission,' Mammalia, p. 41, footnote, I remarked that the additional prism on the last upper molar of *A. saxatilis* and *A. brandti* appeared to be quite as important as the presence of one ridge more, than in other species, on the first upper molar of *A. sikimensis*. After a more extensive study of the genus than I had the opportunity of making in Calcutta, I prefer to modify this view. The last upper molar in *Arvicola* appears to be more variable than the first, and differences in the latter tooth appear therefore more important for purposes of classification than similar characters in the former. At the same time, I see no reason to alter the view I then expressed that such differences are not of generic value.

of the angles on opposite sides of the molars corresponding and the spaces on the crowns of the teeth being consequently double or diamond-shaped instead of triangular, and their number necessarily smaller. The number of internal and external angles in the first and second upper molars is however, the same as in *A. sikimensis*, and the species may therefore, for the present, be assigned to the same section.

The Western-Asiatic form above referred to as resembling *Neodon* in its dentition is *A. guentheri*, Danford and Alston*, from Asia Minor. The posterior inner angles on the first and second upper molars, judging from the figure given, are less developed than in *A. sikimensis* (but still they exist), and all the molar teeth, both in the upper and lower jaws, are very similar to those in the Sikkim species. Externally *A. guentheri* is very different, as it has but a rudimentary thumb without any claw, a much shorter tail, different coloration, &c.

The following table will show how the species of Himalayan and Tibetan Voles hitherto described may be distinguished by the characters of their teeth:—

- I. The anterior upper molar has 3 angles inside and 3 outside ; the second 2 inside and 3 outside. The anterior lower molar has normally 7 spaces.
 - A. The posterior upper molar terminates behind in a narrow process, prolonged backwards in the line of the jaw.—ALPICOLA.
 - a. The posterior upper molar has two strong internal angles and four weak outer angles, the two anterior of the latter widely separated from the two posterior.
 - a. The posterior lobe of the last upper molar behind the second inner angle is much less than half the length of the tooth..... 1. *A. stoliczkanus*.
 - β. The posterior lobe of the last upper molar behind the second inner angle is half the length of the tooth..... 2. *A. stracheyi*.
 - b. The posterior upper molar has 2 internal and 3 external angles 3. *A. wynnei*.
 - c. The posterior upper molar has 3 angles on each side.
 - a. In the anterior lower molar the first inner angle is behind (proximal to) the first outer 4. *A. roylei*.
 - β. In the anterior lower molar the first inner angle is in front of (distal to) the first outer 5. *A. blanfordi*.
 - B. The posterior upper molar does not terminate behind in a narrow process prolonged backward in the line of the jaw.—PALUDICOLA.
 - a. The posterior upper molar has 3 external angles, and the first lower molar 4.....6. *A. blythi*
 - β. The posterior upper molar has 4 external angles, and the first lower molar 5..... 7. *A. mandarinus* ?

* P. Z. S. 1880, p. 62, pl. v.

II. The anterior upper molar has 4 angles inside and 3 outside; the second 3 inside and 3 outside; the anterior lower molar has normally 9 spaces.—NEODON.

A. The posterior inner angle in the two anterior upper molars is weaker than the other inner angles of the same tooth; the last upper molar ends with an internal projecting spur; the first lower molar has 6 well-marked angles inside 8. *A. sikimensis*.

B. The posterior inner angle in both the anterior upper molars is usually equal or nearly equal to the others; the last upper molar, as a rule, does not terminate with an internal spur; the first lower molar has 5 well-marked angles inside 9. *A. melanogaster*.

N.B. The differences in the molar teeth of the last two species are not constant, and the distinction of the species depends on external characters.

In the next table an attempt is made to discriminate the forms by external characters:—

I. Thumb rudimentary and clawless.

Colour light ferruginous brown 1. *A. stoliczkanas*.

Colour light brown, with a grey tinge 2. *A. stracheyi*.

II. Thumb with a small claw.

A. Ears short, not projecting beyond the fur.

Colour dark rich brown, lower parts light brown 3. *A. wynnei*.

Colour yellowish brown, with a rufous tinge; lower parts buff 4. *A. roylei*.

Colour earthy brown; lower parts whitish 6. *A. blythi*.

Colour light greyish rufescent brown (isabelline); lower parts white 7. *A. mandarinus*;

B. Ears projecting beyond the fur.

a. Ears only projecting by about one third of their length.

Colour dark yellowish or rufous-brown; underparts slaty grey; hind foot $\frac{6}{10}$ inch, ear less than $\frac{2}{3}$ inch long 9. *A. melanogaster*

b. Ears projecting by fully half their length.

Colour dark yellowish brown; lower parts slaty grey; hind foot $\frac{3}{4}$ inch, ears fully $\frac{1}{2}$ inch long; tail one third the length of the head and body 8. *A. sikimensis*.

Colour light greyish rufescent brown; ears nearly $\frac{3}{4}$ inch long; tail half the length of the head and body 5. *A. blanfordi*.

Section I. ALTICOLA.

The first lower molar with, normally, 7 spaces, 4 or 5 external and 5 internal angles; the first upper molar with 5 spaces, 3 inner and 3 outer angles; the second with 4 spaces, 3 outer and 2 inner angles; the third terminating in an elongate lobe, produced backwards in the line of the jaw.

1. *Arvicola stoliczkanus*.

Arvicola stoliczkanus, *W. Blanford, J. A. S. B.* 1875, xliv. pt. 2, p. 107 ;
Scient. Res. Second Yarkand Miss., Mamm. 1879, p. 42, pl. viii. fig. 1,
pl. x b. fig. 2.

Colour bright ferruginous brown above*, white below, the two colours sharply divided ; feet and tail white.

Fur soft, rather woolly, dark leaden grey at the base, the terminal fourth on the back rufous-white, tipped with darker rufous, numerous rather longer hairs with dark rufous-brown tips being intermixed.

Ears small, completely concealed by the fur, covered with short bright rufous hair towards the margin inside, and with longer and paler hair outside.

Feet small ; claws long, compressed, much concealed by long white hairs ; thumb quite rudimentary and clawless. Tarsus hairy below, and with a few hairs between the pads of the toes.

Tail short, apparently about a quarter the length of the head and body together, covered with stiff fulvescent white hair, which extend half an inch beyond the end.

	inches.
Length of head and body	4·0
" tail without hairs	1·0
" tarsus and hind foot with claws ..	0·7
" skull	1·15

The description and measurements are from dried skins.

The following are the characters of the molar teeth :—

Upper molar I,	5	spaces,	3	external	and	3	internal	angles.
" " II,	4	"	3	"	"	2	"	"
" " III,	3	"	4	"	"	2	"	"
Lower molar I,	7	"	5	"	"	5	"	"
" " II,	5	"	3	"	"	3	"	"
" " III,	3	"	3	"	"	3	"	"

The hinder upper molar has two strong salient angles on the anterior portion of the inner side ; on the outer side there are anteriorly two weak angles rather close together, then a deep sinus or emargination opposite to the second inner angle, and behind this the tooth terminates in a narrow elongate process with two slight projecting angles on the external side only, none on the inside. This process behind the second inner angle is much less than half the length of the tooth.

The only two specimens of this species hitherto examined are from the high plateaus of Northern Ladák (Western Tibet).

* In the figure given in the 'Scientific Results of the Second Yarkand Mission the colour is too dull and brown : it should be more rufous.

2. *Arvicola stracheyi*. (Teeth, Plate I. fig. C.)

Arvicola stracheyi, *Oldfield Thomas, Ann. & Mag. Nat. Hist.* Oct. 1880, ser. 5, vol. vi. p. 332.

Colour light brown, with a grey tinge above, white below; forehead rather dusky; feet and tail white.

Fur soft, long, slaty grey at the base; on the back there is a pale whitish band on the hairs, a little way from the skin (this may, perhaps, be an individual peculiarity or due to season, only one specimen being known) the first and third fourths of the length being slaty grey and the terminal fourth brownish yellow, some hairs with black tips being interspersed. On the lower parts the basal half of the hairs is grey, the terminal half white.

Ears small, not projecting beyond the fur and thickly covered inside and out with moderately long hair.

Feet of moderate size; claws pale, overhung with hairs; thumb quite rudimentary and clawless; fourth toe in the fore foot slightly longer than the second, and the third longer than the fourth by about the same difference. In the hind foot the second and fourth toes are nearly equal, third very little longer. Tarsus hairy below.

Tail short (vertebræ preserved), apparently not more than one fifth the length of the head and body, covered with white hairs, which extend half an inch beyond the end.

	inches.
Length of head and body	3·7
„ tail without hairs.	0·7
„ tarsus and hind foot without claws...	0·65

The description and measurements are from a single dried skin brought by Capt. (now Lieut.-Gen.) R. Strachey from Kumaon, and presented to the East-India Museum, where it was entered in the Catalogue as *Cricetus songarus*. When the zoological specimens of the East-India were incorporated in the British Museum, the skull was extracted by Mr. Thomas and the real nature of the animal recognized.

The following are the characters of the molar teeth:—

Upper molar	I, 5	spaces, 3	external and 3	internal angles.
„	„	II, 4	„ 3	„ „ 2
„	„	III, 3	„ 4	„ „ 2
Lower molar	I, 7	„ 5	„ „ 5	„ „
„	„	II, 5	„ 3	„ „ 3
„	„	III, 4	„ 3	„ „ 3

The hinder upper molar much resembles that of *A. stoliczkanus*, and like the latter, has two strong salient angles on the anterior portion of the

inner side followed by the straight inner edge of the long posterior lobe. On the outer side there are, anteriorly, two weak angles rather close together, then a deep sinus opposite to the second inner angle, and behind this the tooth terminates in a narrow elongate process with two slight angles on the outer side only; none inside. This process, behind the second inner angle, is half the length of the tooth.

In the first lower molar the anterior inner and outer angles are almost rudimentary on the crown, but they form distinct folds on the sides of the tooth*. The first three spaces in this tooth are confluent, the first two especially are scarcely separable. The same is the case with the first and second spaces in the second lower molar, and with the second and third spaces in the third; in the latter case the two are just sufficiently distinguishable to be counted apart.

3. *Arvicola wynnei*. (Teeth, Plate I, fig. B.)

Arvicola wynnei, *W. Blanford, J. A. S. B.* 1880, Vol. XLIX, Pt. II, p. 244.

Colour above dark rich brown, with a slight greyish tinge†; head rufescent; lower parts pale brown; tail the same colour as the back; feet covered with brown hairs above, soles pale.

Fur very soft; hairs very dark leaden grey, nearly black at the base, and for three fourths to four fifths of their length on the back, the tips being rufous-brown in general, some more or less grey; the terminal portion on the lower parts pale brown. No longer hairs on the back; a few scarcely exceeding the rest of the fur, on the rump. The length of the hair on the back in skins collected in the summer and autumn is half an inch or rather less.

Ears short and rounded, completely concealed by the fur, thinly clad with long hair on the external surface, and with short brown hair on the inside towards the border; a tuft of long hair on the anterior edge of the inner surface.

Whiskers brown, the lower greyish, the longest reaching the ear.

Feet moderate; fore feet rather large; claws long, compressed, white, not overhung with long hairs. Thumb of fore foot short, with a short compressed claw; the middle toe exceeds the fourth by about half the length of the terminal phalanx; the fourth is scarcely longer than the second, which extends by about the length of its last phalanx beyond the fifth. In the hind foot the third toe is very little longer than the second,

* They are not counted in the original description; but I think that similar folds should be noticed, and they appear to be included by Blasius.

† In one specimen preserved in spirits the greyish tinge is wanting, and the colour above dark chestnut.

which, again, is but little longer than the fourth. This exceeds the fifth by more than the length of its last phalanx, and the fifth is longer than the first by about half the same length. There are five pads or tubercles beneath the fore foot; the two hinder the largest, opposite to each other and to the base of the thumb; the three distal pads small, and arranged in a triangle at the base of the toes. On the sole of the hind foot there are also five tubercles—two in front, one on each side of the base of the middle toe, another pair at the base of the two outer toes, the outer nearer the distal extremity of the foot than the inner, and the fifth at the proximal extremity of the naked sole, and about as far behind that at the base of the fifth toe as the latter is from the pair at the base of the middle toe. Lower portion of tarsus hairy.

Tail between one third and one fourth the length of the head and body, almost cylindrical, diminishing but little in thickness towards the end, clothed with long hair at the base, and with short brown hair throughout the terminal three quarters of its length. The hairs only project one eighth to one fourth of an inch beyond the end of the tail.

The following are the dimensions of the specimens, both adult males, in spirit* :—

	in.	in.
Length of head and body from nose to vent	4.75	3.5
Tail from vent (hair at end not included)	1.35	1.2
Height of ear from orifice	0.25	0.26
Breadth of ditto	0.25	0.26
Length of fore foot without claws	0.4	0.4
„ hind foot and tarsus without claws	0.7	0.7
„ claw of middle toe	0.11	0.13

The incisors are deep orange. The following are the characters of the molars :—

Upper molar	I, 5	spaces, 3	external and 3	internal angles.
„	„	II, 4	„ 3	„ „ 2 „ „
„	„	III, 4	„ 3	„ „ 2 „ „
Lower molar	I, 7	„ 4	„ „ 5	„ „
„	„	II, 3	„ 3	„ „ 3 „ „
„	„	III, 3	„ 3	„ „ 3 „ „

The two anterior upper molars resemble those in all other Himalayan *Arvicolæ* except *A. sikimensis* and *H. melanogaster*, and in the majority of European and American forms. The hinder upper molar has two small salient angles on the outer side in front, much closer together and smaller than the two inner angles. Behind the second outer angle there is a sinus,

* Spirit-specimens always measure rather less in the length of the body and ears than freshly-killed animals.

a very little deeper and somewhat broader than that between the first and second. The posterior portion of the tooth is a nearly oval longitudinal lobe, forming rather more than one third the length, more prominent externally than internally, so as to form a blunt third external angle, but not sufficiently prominent on the inner side to form a third inner saliency. The spaces or prisms of a tooth like this are always somewhat indefinite; the first space is enclosed by the anterior outer and the corresponding inner angle; the second is not separated from the first, and is enclosed by the second outer angle, the third by the second inner angle, and the fourth corresponds to the posterior lobe.

In the first lower molar the first three spaces are confluent, and so are the fourth and fifth. The anterior outer and inner angles project less than those behind; the first inner angle especially, which is close to the extremity of the tooth, and much in advance of the first outer angle, is weak and rounded; these two anterior angles enclose the first space, which is oblong-ovate, with its longer diameter diagonally placed. The third inner and outer angles are so nearly opposite to each other that it is almost a question whether the two spaces they enclose should not be considered as one. In the second and third lower molars all the spaces are lozenge-shaped, the outer and inner angles being nearly or quite opposite to each other, and each space being bounded both by an exterior and an interior angle. The outer external angles of the third lower molar are rather less prominent than the inner. The third molar is considerably narrower than the second, and the second somewhat narrower than the first.

The interparietal bone is subtriangular. The hinder margin, neglecting small projections and emarginations, runs nearly straight, and consists of two slightly concave halves meeting in a trifling angle, projecting in the middle; the anterior margin is formed by two almost straight lines meeting in the middle of the skull at an angle a little more open than a right angle, without any point projecting anteriorly beyond the angle. The nasals in the only skull I have extracted are slightly injured behind, so I cannot determine the shape of the posterior extremity; the outer edge of each appears to be convex throughout, not emarginate posteriorly.

The following are the dimensions of a skull:—

	inches.
Length from occipital plane to end of nasals	1·14
„ of nasals	0·34
Breadth across widest parts of zygomatic arches	0·74
„ between orbits where narrowest	0·18
„ of nasal bones in front	0·14
„ of interparietal bone	0·23
Length of upper molars together	0·28

Distance from upper molars to incisors	0·38
Length of lower jaw from condyle to symphysis	0·75
„ of lower molars together	0·27

This species has been described from two specimens in spirit and two skins, procured at the hill-station of Mari (Murree) in the Punjab by Mr. A. B. Wynne, of the Geological Survey of India. All the specimens were captured, I believe, by a house-cat; so the animal is probably common in the gardens of the station. The native name is *Kanis* (Kunnees).

There is in the British Museum a specimen in spirit of an *Arvicola* of unknown locality, but probably Himalayan, and very possibly from Kashmir, having the same dentition as *A. wynnei*, but differently coloured with larger ears. This specimen was obtained by purchase, together with a specimen of *Nesokia bengalensis* (*N. indica*, Blyth and Jerdon) and some other mammals, all apparently Indian, but all supposed at the time to be from Africa. I shall not name a specimen of such dubious antecedents; there is not sufficient evidence that it is even Indian, or that it comes from the same country as the associated specimens; but as it is far from improbable that it may prove to be Himalayan, the following characters may enable the species to be identified when met with:—

Colour brown (about the same as a wild rabbit, not dark rufous brown like typical *A. wynnei*) above, whitish below. The tail much darker above than below. Feet brown above, similar in proportions and pads to those of *A. wynnei*. Ears rounded, projecting considerably beyond the fur. Teeth as in *A. wynnei*.

	inches.
Length of head and body from nose to vent	4
„ tail from vent (hair at end not included)	1·3
Height of ear from orifice	0·42
Breadth of ditto	0·37
Length of forefoot without claws	0·35
„ hindfoot and tarsus „	0·7

It should be mentioned that the peculiar form of the last upper molar, characteristic of the Section *Alticola*, has hitherto only been found in Himalayan species of *Arvicola*.

4. *Arvicola roylei*. (Teeth, Plate I. fig. D.)

Arvicola roylei, Gray, *Ann. & Mag. Nat. Hist.* Vol. X, p. 265 (1842); Schreber, *Säugeth. Suppl.* III, p. 587 (1843); Giebel, *Säugeth.* p. 613 (1859); ? Blyth, *Cat. Mamm. Mus. As. Soc.* p. 125 (1863); Jerdon, *Mammals of India*, No. 202, p. 216 (1867).

Colour above yellowish brown,* rather rufous in the middle of the back, below paler and isabelline or fulvous; tail brown above, white below; feet apparently the same colour as the lower parts.

Fur dark slaty at the base and for about two thirds of the length, the terminal third being tawny at first, the tips partly brown, partly black on the upper parts; on the lower parts all the tips are tawny.

Ears small, hairy, concealed by the fur.

Feet small; claws pale, short, overhung by hairs; thumb in the fore foot very small, but with a distinct claw; middle finger but little longer than the fourth, which is considerably longer than the second. The characters of the toes in the hind feet, which are contracted in the dried skin, cannot be made out clearly.

Tail nearly cylindrical, apparently rather more than a third of the length of head and body together, and covered with short hair, which only extends a short distance beyond the end, and is rather darker and more rufescent above than below.

The measurements are taken from the dried skin (1); those given by Jerdon, from a specimen collected by himself, are added (2) as will be shewn presently, it is not certain that this specimen was of the same species.

	(1)	(2)
	in.	in.
Length of head and body.....	3	3.75
„ of tail-vertebræ	1.1	1.375
„ of tarsus and hind foot without claws.....	0.8	

The following are the characters of the molar teeth:—

Upper molar I, 5 spaces, 3 external and 3 internal angles.

„ „ II, 4 „ 3 „ „ 2 „ „

„ „ III, 3 „ 3 „ „ 3 „ „

Lower molar I, 7 „ 4 „ „ 5 „ „

„ „ II, 5 „ 3 „ „ 3 „ „

„ „ III, 3 „ 3 „ „ 3 „ „

In the first upper molar the anterior outer angle is a little in front of the corresponding inner angle. The last upper molar has three nearly

* Gray calls the colour rufous-grey. As he undoubtedly described the same skin as I have examined, I can only say that his ideas of coloration were different from mine, for it is difficult to believe that the colour has changed from rufous-grey to yellowish brown. A change from yellowish brown to rufous-grey would be far more likely to result had the specimen been exposed to light; to the best of my belief, however, the skin has not been exposed. Jerdon calls the colour ashy brown, with a tinge of rufous more or less apparent; but he described different specimens, and as he did not examine the teeth it is by no means certain that they belonged to the same species.

equidistant outer angles, but the hollow between the two posterior angles is much deeper than that between the two anterior, the three inner angles are also nearly equidistant; the hindmost portion of the tooth behind the third internal angle is a longitudinal lobe, forming about one third of the whole length, and without angles; the anterior space is continued between the first inner and first and second outer angles; the second space corresponds to the second inner angle; the third space is enclosed by the posterior angle on each side and the lobe.

In the first lower molar the anterior angle on each side is very small and blunt, and there is a rudimentary fifth external angle in front; the first and second spaces, the latter corresponding to the second inner angle, are not separate. In the second lower molar the first space is confluent with the second, and the third with the fourth. Similarly in the third lower molar the first and second spaces are not distinct, nor are the third and fourth.

The above description is from the single type, a dried skin in poor condition, obtained by Royle in Kashmir. Jerdon states that he found this species in Kunawar near Chini, and observed it on the Pir-Panjaj pass, south of Kashmir; but he had no opportunity of comparing specimens; and as so many additional species have since been described it is possible the voles he saw may not have been *A. roylei*. The locality given by Blyth (Pind Dádun Khán, in the Panjab) is probably, as already noticed, due to a mistake.

5. *Arvicola blanfordi*. (Teeth, Plate I, fig. E.)

Arvicola blanfordi, *J. Scully, Ann. & Mag. Nat. Hist.* Nov. 1880, Ser. 5, Vol. VI, p. 399.

Colour above rather light greyish brown, with a very slight rufous tinge, below greyish white; feet white; tail brown above, sullied white below.

Fur soft, the hairs slaty grey at the base, and on the back for about three quarters of their length, the terminal fourth on the upper parts fawn-colour, numerous rather longer hairs with black tips being interspersed. On the lower parts the tips of the hairs are white.

Ears of moderate size, rounded, projecting considerably beyond the fur, covered with moderately short hair inside near the margin, and outside except on the anterior part of the outer surface, where the hair is longer.

Whiskers long, some of them extending beyond the tips of the ears, the greater portion white, a few dark brown.

Feet of moderate size; claws white, compressed, not long, overhung with long hairs; thumb of fore foot very small, almost rudimentary, but

furnished with a small claw; middle finger very little longer than the fourth, but there is much more difference between the latter and the second, about as much as there is between the second and fifth. Tubercles beneath the fore foot five in number, all of good size and near together, three in a triangle at the base of the middle toes, and two opposite to each other and to the base of the thumb. In the hind foot the second and fourth toes are very nearly the same length, and but very little shorter than the third; the fourth exceeds the fifth by rather more than the length of the terminal phalanx of the former, and the difference between the fifth and first is less, being about the length of the distal phalanx of the fifth toe. There are six pads or tubercles on the sole of the hind foot, the three inner much further apart than the three outer, the last outer being rather smaller than the rest, and the last inner pad, which is considerably behind all the others, being situated rather nearer to the most distal tubercle than to the heel. Lower portion of tarsus well covered with hair.

Tail between one third and one half the length of the head and body, cylindrical, scarcely diminishing in diameter towards the tip, well clad with hair, which projects about one fifth of an inch beyond the end of the vertebræ.

The following dimensions are (1) of a fresh adult male specimen taken by Dr. Scully, and (2) of an adult male in spirit:—

	(1)	(2)
	in.	in.
Length of head and body from nose to vent	4.55	3.9
„ of tail from vent (hair at end not included)	2.05	1.9
Length of ear from orifice.....	0.7	0.58
Breadth of ear ..	0.68	0.54
Length of fore foot without claws	0.4	0.4
„ of hind foot from heel with out claws.....	0.75	0.76

The molars have the following characters:—

Upper molar I, 5 spaces, 3 external and 3 internal angles.

„ „ II, 4 „ 3 „ „ 2 „ „

„ „ III, 4 „ 3 „ „ 3 „ „

Lower molar I, 7 „ 4 „ „ 5 „ „

„ „ II, 5 „ 3 „ „ 3 „ „

„ „ III, 3 „ 3 „ „ 3 „ „

In the first upper molar the anterior outer angle is distinctly nearer the hinder part of the jaw than the anterior inner angle. The third upper molar has three nearly equidistant outer angles, the sinus intervening between the second and third angle being much deeper than that between the first and second. The inner angles in this tooth are much more promi-

nent than the outer. The longitudinal lobe forming the posterior portion of the tooth behind the third internal angle is of small length, scarcely one fourth of the tooth; there are two rudimentary external and one internal angle on the lobe that are not counted. The spaces are not very different from those in *A. roylei*, although one more is counted; the first is bounded by the first internal and first two external angles; the second corresponds to the second internal angle; the third, which is small, to the third external angle, whilst the fourth is included by the third internal angle and the posterior lobe.

On the first lower molar there is a rudimentary anterior external angle that has not been counted, the first internal angle is much smaller than the others, and the first external somewhat less prominent. The first and second spaces, the latter corresponding to the second inner angle, are not separated. In the third molar the second space is almost double, the two angles not being quite opposite, and it is a question whether this tooth should be considered as having 3 spaces or 4.

Interparietal with the hinder border almost straight; each of the lateral margins forms an ogee curve, concave anteriorly, convex behind, and meeting the posterior margin at an angle rather less than a right angle. The lateral angles are not produced; the anterior angle projects very slightly forward.

Dr. J. Scully has done me the honour of naming this Vole after me. It is found commonly on the mountains around Gilgit at an elevation of 9000 to 10,000 feet. It is closely allied in the structure of the teeth to *A. roylei*, but differs widely in external characters, the tail and ears being much longer and the coloration quite different.

This species, in which the posterior lobe of the last upper molar is less developed than in the other four forms of the section, shows a passage to *Paludicola*.

SECTION II. PALUDICOLA.

The first lower molar with normally 7 spaces, 4 or 5 external and 5 internal angles; the first upper molar with 5 spaces, 3 inner and 3 outer angles; the second with 4 spaces, 5 outer and 2 inner angles; the third not terminating in an elongate lobe.

6. *Arvicola blythi*. (Teeth, Plate II, fig. B.)

Phaiomys leucurus, *Blyth*, *J. A. S. B.*, 1863, XXXII, p. 89; *Theobald*, *J. A. S. B.*, 1862, XXXI, p. 519; *Stoliczka*, *J. A. S. B.*, 1865, XXXIV, p. 110. *Nec Arvicola leucurus*, *Gerbe* (1852); *nec idem*, *Severtzoff* (1873).

Arvicola blythi, *W. Blanf. J. A. S. B.*, 1875, XLIV, pt. 2, p. 107; *id. Scientific Results Second Yarkand Mission, Mammalia*, p. 39, pl. VIII, fig. 2, & pl. X, b. fig. 1.

Colour above earthy brown (yellowish brown with a greyish tinge), below brownish white. Feet the same colour as the underparts; tail light brown.

Fur soft, the basal two thirds on the upper surface, and about one half on the lower, dark slaty; the tips on the upper surface of two kinds—the finer isabelline, the coarser dark brown, almost black; tips on the abdomen brownish white.

Ears small, round, not extending beyond the fur, thinly clad with light-brown hairs inside, more thickly and with longer hairs outside.

Whiskers dark brown above, white below, the longest nearly an inch in length.

Feet of moderate size; claws compressed, horn-coloured; thumb short, with a short compressed claw.

Tail cylindrical, about one fourth to one third the length of the head and body, covered with short hair.

The following dimensions are (1) from a fresh specimen taken by Dr. Stoliczka, (2) from another fresh specimen, a large female, by Mr. Theobald, (3) from an adult specimen in spirit:—

	(1)	(2)	(3)
	in.	in.	in.
Length of head and body	4	4·9	3·7
„ of tail, without hairs at end.....	1·35	1·25	1·1
„ of ear			0·33
Breadth of ear			0·37
Length of fore foot and claws			0·45
„ of hind foot and claws... ..			0·82
„ of skull			1·03

The following are the characters of the molar teeth:—

Upper molar I, 5 spaces, 3 external and 3 internal angles.

„ „ II, 4 „ 3 „ „ 2 „ „

„ „ III, 5 „ 3 „ „ 3 „ „

Lower molar I, 7 „ 4 „ „ 5 „ „

„ „ II, 5 „ 3 „ „ 3 „ „

„ „ III, 4 „ 2 „ „ 3 „ „

In the third upper molar all the internal angles are much more prominent than the outer, and the first two internal angles are more developed than the last. The first space is included by the first internal and first external angle, the second space by the second external angle, the third by

the second internal, the fourth by the third external, and the fifth by the third internal angle; the last two are not separate, but form together an inequilateral arrowhead,* the internal angle being nearer to the posterior extremity of the tooth, but directed forwards, and with a deeper notch in front of it than the other angles.

In the first lower molar the first outer angle is much rounder and less prominent than the others. The third lower molar is peculiar, as the usual anterior outer angle is completely wanting,† and the first outer angle (corresponding to the second in other *Arvicolæ*) is very small and not so prominent as the second, which, again, is inferior in size to each of the three inner angles. The first space corresponds to the first inner angle, the second space to the second inner and first outer, the third space to the second outer angle, and the fourth space to the third inner angle. The last two spaces are confluent in some specimens.

The interparietal has the hinder edge nearly straight, and the two lateral edges forming an ogee curve, the concave portion near the anterior angle, the convex external; the anterior angle slightly prominent, the lateral angles not so, each of the latter being a little less than a right angle.

This species has been obtained in two parts of Western Tibet—on the banks of the Tsomoriri, a large lake north of Spiti, and in the country between Leh and the Pankong lake in Ladák. Both places are at a considerable elevation, over 13,000 feet above the sea.

7. *Arvicola mandarinus*?, var. (Teeth, Plate II, fig. C.)

♀ *Arvicola mandarinus*, *A. Milne-Edwards, Recherches Mammifères*, p. 120, pl. XII, fig. 4, pl. XIII, fig. 4.

Golunda meltada, *Gray* ("var. or distinct species from Griffith's collection in Afghanistan"), *Horsf. Cat. Mamm. Mus. E. I. Co.*, p. 144.

The following description is that of the Afghan skin in the British Museum:—

Colour rufescent fulvous (light greyish rufescent brown) above, white beneath; tail the same as the back; feet whitish.

Fur soft, basal two thirds leaden black; tips isabelline (pale fulvous), a few slightly longer black tips interspersed throughout the dorsal surface.

Ears short, concealed by the fur, hairy inside and out.

Feet of moderate size; thumb of fore foot very short, but furnished

* In the description of the Mammalia of the Second Yarkand Mission I described this tooth as composed of four lobes, the two posterior spaces being counted together.

† A somewhat similar character is shown in Blasius's figure of the corresponding tooth in *A. agrestis* (Säugh. Deutschl. p. 370) and in that of the *petrophilus*-form of *A. nivalis* (ib. p. 360), but not to the same extent as in *A. blythi*.

with a claw; claws of moderate length, pale in colour, overhung by the hairs of the toes. In the fore foot the difference between the fourth and second toes is about double that between the third and fourth, and equal to that between the second and third. In the hind foot the third toe is distinctly the longest, and there is but little difference between the second and fourth; tarsus hairy beneath.

Tail about a quarter the length of the head and body (judging from the dried skin), covered with short hairs extending about $\frac{1}{8}$ inch beyond the end.

	inches.
Length of skin from nose to vent	4
„ tail without hairs at end (the vertebræ preserved)...	1
„ hind foot, without claws.....	0.67

The skull extracted from the skin is imperfect, and the hinder portion (including the interparietal) is wanting. The nasals are rounded at their posterior extremity; they do not extend quite so far back as the premaxillaries, and their outer edges are slightly concave. The following are the characters of the molar teeth:—

Upper molar I,	5	spaces,	3	external	and	3	internal	angles.
„ „ II,	4	„	3	„	„	2	„	„
„ „ III,	5	„	4	„	„	3	„	„
Lower molar I,	7	„	5	„	„	5	„	„
„ „ II,	5	„	3	„	„	3	„	„
„ „ III,	$\frac{1}{2}$	„	2	„	„	3	„	„

On the third upper molar there is a rudimentary fourth inner angle; the third and fourth outer angles are less marked than the others; the spaces might be reckoned either 4 or 6; the three first are well separated, but not those behind. In the first lower molar the two anterior external angles are blunt and ill-developed; they, with the first internal angle, enclose one space. In the third lower molar, as in the corresponding tooth of *A. blythi*, the usual anterior external angle is entirely wanting; the second and third spaces are imperfectly separated.

The molars thus closely resemble those of *A. blythi*, but there is an additional outer angle on the third upper molar and another on the first lower molar, whilst the first outer angle on the third lower molar is better developed and includes a space to itself. These differences are not of specific value by themselves, but the external differences are more important.

I have examined the types, two in number, of *A. mandarinus*, in the Paris Museum (Jardin des Plantes). They are rather browner than the Afghan specimen, but otherwise coincide very fairly; they have a small thumb with a claw. The colour is light rufous-brown, and the fur is long

Fur soft, leaden grey at the base ; the terminal fourth on the back light brown, almost tawny, with numerous rather longer black-tipped hairs intermixed. On the underparts the extreme tips only of the hair are whitish ; but here also longer and coarser hairs with dirty-white ends, are intermixed.

Ears not covered by the fur, but projecting for about half their length, rounded, very thinly clad inside and out with short dark-brown hair. A tuft of long hair on the base, just below the orifice, and long hair on the anterior part of the outer surface. The anterior portion of the inner and posterior portion of the outer surface almost naked.

Whiskers of moderate length, extending to the ears, but not beyond them ; some black, others grey.

Feet of moderate size ; claws horn-colour, not white, short, compressed, overhung by hairs, which often exceed the claws themselves in length. Thumb very short, but furnished with a small claw. The middle toe in the fore foot only just longer than the fourth, which exceeds the second by nearly the length of the terminal phalanx ; the fifth only comes short of the second by about half the same length. Tubercles on the sole of the fore foot 5 in number, the three anterior arranged in a triangle at the base of the four longer toes, the posterior pair opposite each other in a transverse line at the base of the thumb, that nearest the thumb being especially large. In the hind foot the three middle toes differ but little in length, the third just exceeding the fourth, which is a little longer than the second ; the latter, by the length of its terminal phalanx, exceeds the fifth, and there is a still greater difference between the fifth and the first. The pads or tubercles are 6 in number, one, however, being very small and very possibly wanting* in some individuals ; the two anterior are close together, the inner of the two being nearer the heel or proximal to the other, the third a little further back at the base of the fifth toe, the fourth at the base of the first, the posterior pair as far behind the second pair as the fourth pad is behind the second ; the outer of the last pair is thus considerably in advance of the inner, and is small and rudimentary ; the last of all is situated about halfway between the base of the middle toe and the heel. The tarsus is almost naked below.

Tail fully one third the length of the head and body, or rather more, diminishing gradually (not rapidly) in thickness behind, thinly clad with short brown hair, which projects but little beyond the end.

scribed the colour above as " deep brownish black, with a slight rusty shade, minutely and copiously grizzled with hairs of a deep ferruginous tint." This may indicate that some individuals are much more rufous than those I have examined.

* It was wanting in the specimens examined by Hodgson.

The following measurements are (1) those given by Hodgson,* apparently from a fresh specimen, (2) from an adult female specimen in spirits:—

	(1)	(2)
	in.	in.
Length of head and body from nose to vent	4·75	4
Tail from vent (hair at end not included)	1·75	1·6
Height of ear from orifice.....		0·5
Breadth of ear		0·35
Length of fore foot (palma), without claws	0·44	0·35
" of hind foot and tarsus, without claws	0·75	0·72

There are 6 teats according to Hodgson, but 8 in his MS. notes. In the specimen before me I find two pairs on the breast, both postaxillar; the inguinal mammæ appear undeveloped, and cannot be distinctly traced. The true number must be 8 at least.

Incisors deep orange. The following are the characters of the molar teeth:—

Upper molar I, 5 spaces, 3 external and 4 internal angles.					
" " II, 5 " 3 " " 3 " "					
" " III, 6 " 3 " " 4 " "					
Lower molar I, 9 " 5 " " 6 " "					
" " II, 5 " 3 " " 3 " "					
" " III, 3 " 3 " " 3 " "					

The hindmost inner angle of the first upper molar is much smaller than the others, and does not enclose a distinguishable space. The hindmost inner angles of the second and third upper molars are also smaller than the other angles of those teeth, and the enclosed spaces are not distinctly separate from those preceding. In the first lower molar the second space is imperfectly separated from the third, and the third from the fourth.

This species has hitherto only been found in Sikkim, at elevations of from 7000 to 10,000 feet. It inhabits forests, and, according to Hodgson, breeds in fallen trees.

Amongst the original drawings of Nepalese and Sikkim Mammalia presented to the Zoological Society of London by Mr. Hodgson, there are figures of *Neodon sikimensis* and *Arvicola thricotis*, the name *thricolis* of the British Museum catalogue being manifestly a misprint. These sheets, like those bearing other drawings in the same collection, are covered with MS. notes on habits and structure, visceral anatomy, &c., showing what a very large number of important observations Mr. Hodgson had accumulated. It may be added that when these drawings were made, the anatomy of allied European forms was very imperfectly known, but that, since fuller

* Horsfield, from Hodgson's MS., P. Z. S. 1856, p. 401.

descriptions have been published, a large proportion of the anatomical details figured and explained in Mr. Hodgson's notes prove to be common to whole genera or even families. Such is the case in the present instance. There appears nothing in the anatomy of *A. sikimensis* to distinguish that species from European Voles.*

The intestines in two specimens, both females, were 26 and 28 inches long, the cæcum $3\frac{3}{4}$ and 4 inches, and $\frac{3}{8}$ wide, in one case 10 inches, in the other 13 from the anal end of the intestine. In a male the intestines measured 25 inches; the cæcum, 11 inches from the anus, was $6\frac{3}{4}$ inches long and rather less than half an inch broad. "Liver 3-lobed, each lobe divided, and a lobulus. Gall-bladder deeply imbedded in largest and central lobe, and having a large clear duct. Spleen 1 inch, tongue-shaped, and deep red." In the stomach the two orifices are said to be about a quarter of an inch apart.

Several measurements, evidently from fresh specimens, are given. They are useful as showing to some extent the amount of variation.

	1, ♂	2, ♀	3, juv.	4, ♂	5, ♀
	in.	in.	in.	in.	in.
Length from nose to anus.....	$4\frac{3}{8}$	$4\frac{1}{4}$	$3\frac{2}{5}$	$4\frac{1}{8}$	4
„ of head to nape	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{3}{15}$	$1\frac{1}{5}$
„ from snout to fore angle of eye.	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{7}{17}$	
„ thence to base of ear	$\frac{5}{8}$	$\frac{1}{16}$	$\frac{1}{2}$	$\frac{10}{16}$	
„ of ear entire	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Breadth of free portion (measured from the skull)	$\frac{5}{16}$...	$\frac{5}{16}$	$\frac{3}{8}$	
Length of tail	$1\frac{3}{4}$	$1\frac{7}{8}$	$1\frac{5}{8}$	$1\frac{7}{16}$	$1\frac{7}{8}$
„ palma and nails	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{7}{16}$
„ planta and nails (from <i>os calcis</i>).	$\frac{3}{4}$	$\frac{1}{16}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{1}{16}$
Weight	$1\frac{1}{4}$ oz.	$1\frac{1}{4}$ oz.	...	$1\frac{1}{4}$ oz.	1 oz.

No. 5 is the type of *Arvicola thricotis*, which is separately figured. It will be seen that there is nothing in the dimensions to show any difference from *A. sikimensis*; the coloration is identical. But of several skins and specimens in spirit presented by Mr. Hodgson, not one is marked as *A. thricotis*; and as the publication of the name does not appear to have been authorized by that gentleman, it is probable that he had recognized the identity of the animal thus named with *A. sikimensis*. In Gray's second edition of the British Museum catalogue of Mr. Hodgson's specimens all that is stated of the species (which has, of course, never been described in print) is:—"Hab. Darjiling, in woods near houses. India Office, Nov. 1852 (in spirits). Compare with *Neodon sikimensis*?" From this it may

* For an account of the anatomy of *A. amphibius* and *A. agrestis* see H. Beger, Zeitschrift ges. Naturwiss. XXX, 1867, p. 145; and Retzius, Müller's Archiv, 1841, p. 403.

fairly be inferred that the type was one of the spirit-specimens recently received at the British Museum from the East-India Museum. All such specimens are unquestionably *A. sikimensis*.

All Mr. Hodgson's specimens appear to have been obtained in Darjiling itself or the immediate vicinity of the station. In one case he obtained a male, female, and two young in a nest, saucer-shaped, made of soft grass, without any lining, 6 inches in diameter. The nest was in a decayed fallen tree in the forest. The young were "2½ inches long, hairy above, nude below, and blind; the ears also closed."

A story current amongst the people is noticed, to the effect that this animal, which the Hindi-speaking Nepalese call *Phal-cha*, or Fruit-Rat, appears at long intervals, and is produced out of the fruit of a tree, a large species of wild olive, said, on Dr. Thomson's authority, to be common in the deep forests of the central and northern region at 7000 to 15,000 feet (neither the botanical nor Nepalese name of the tree is given in the MS. notes). It is probable, from the existence of this story, that these Voles, like some other species of the genus, appear in much larger numbers at times.

9. *Arvicola melanogaster*. (Teeth, Plate II, fig. A.)

Arvicola melanogaster, A. Milne-Edwards, *Nouv. Arch. du Museum*, 1871, Vol. VII, p. 93; *Recherches pour servir à l'histoire naturelle des Mammifères*, Vol. I, p. 284, pls. XLIV, XLVI a.

Colour above varying from dark brown with a greyish tinge to blackish brown, below ashy grey. Tail the same colour as the back above, rather paler and greyer beneath. Feet brown above. In some specimens the head is lighter and more rufous above than the back; but in general there is no difference. Of a variety from Fokien several specimens are bright rufous-brown above. The usual colour, however, is precisely the same as in *A. sikimensis*.

Fur soft, dark leaden grey at the base, tips brown. In the darker specimens (one marked as killed in March) there are much coarser hairs intermixed. In the brown specimens this is not usually the case to the same extent, but there are a few longer black-tipped hairs on the back and rump.

Ears projecting slightly beyond the fur by about one third of their length, not nearly so much as in *A. sikimensis*, thinly clad with short hair inside and out, and with a tuft of long hair on the anterior inner margin near the base.

Whiskers dark brown, a few of the lower grey, the longest extending to the ears, but not beyond.

Feet small; claws white, compressed, moderate in length, only partly

overhung by hairs, which do not extend to the end. In the fore foot the thumb is quite rudimentary, but it has a small claw. Third finger very little longer than the fourth, which exceeds the second; pads five, three in a triangle at the base of the middle toes, two opposite to each other and to the base of the thumb. In the hind foot the middle toe is the longest, as usual, the second and fourth very little shorter and subequal; there is a great difference between the second and fifth toe, less between the fifth and first. Five pads on the sole, besides a rudimentary sixth; of the two anterior pairs the outer is a little more distal than the inner, and the rudimentary sixth pad is equally in advance of the fifth, which is a little nearer to the origin of the middle toe than to the heel.

Tail rather more than one third the length of the head and body, slightly attenuate, covered with short hairs that project very little beyond the end.

The following dimensions are taken from three specimens in spirit in the Museum at the Jardin des Plantes, Paris; (1) is a male and (2) a female from Moupin, (3) a female from Fokien:—

	(1)	(2)	(3)
	in.	in.	in.
Length of head and body from nose to vent...	3·7	3·55	3·7
" tail from vent (hairs at end not included)	1·4	1·35	1·6
Height of ear from orifice.....	0·37	0·38	0·35
Breadth of ear	0·35	0·36	0·35
Length of fore foot (palma) without claws ...	0·35	0·34	0·35
" hind foot from heel without claws ...	0·6	0·6	0·65

The incisors are deep orange. The following are the characters of the molar teeth:—

Upper molar I, 6 spaces, 3 external and 4 internal angles.			
" " II, 5 " 3 " 3 " "			
" " III, 4 " 3 or 4 " 3 or 4 " "			
Lower molar I, 6 to 8 5 " 5 or 6 " "			
" " II, 3 " 3 " 3 " "			
" " III, 3 " 3 " 3 " "			

As was remarked by Milne-Edwards in his original description of this form, the spaces on the two sides of many of the teeth are so nearly opposite that they must often be reckoned as one; and as there is some variation in the degree of alternation or coincidence, the number of spaces is not characteristic. This is especially the case in the anterior lower molar. In the first upper molar spaces 5 and 6 coalesce. The last interior angle is frequently equal to the others, but is more commonly smaller. In the second upper molar the second and third spaces are imperfectly separated,

and so are the fourth and fifth; sometimes the tooth might be considered as having only three spaces. The last inner angle varies in size, but is usually equal or nearly equal to the next in front. In the last tooth the second and third spaces are not distinct; the posterior portion of the tooth varies, generally (as in the example figured herewith) there is a strong third angle inside, and another equally strong (the third) outside, and behind these is a U-shaped lobe with a weak external angle. Sometimes, however, the latter angle is wanting, whilst occasionally, on the other hand, a fourth internal angle is also well developed, as in *A. sikimensis*; and in one specimen this is stronger than the corresponding inner angle.

The anterior lower tooth also varies considerably. The angles on opposite sides are sometimes so perfectly parallel in position that there are only six spaces, the first and second being always imperfectly separated. The anterior inner angle too is very variable, being sometimes as strong as in *A. sikimensis*, sometimes altogether wanting.

The following are the dimensions of a skull:—

	inch.
Length from occipital plane to end of nasals	... 0·9
Breadth across hinder part of zygomatic arches	... 0·56
" between orbits	... 0·19
Length of nasal suture	... 0·24
Breadth of interparietal	... 0·33
Length of upper molars	... 0·22
Distance between upper molars and incisors	... 0·25
Length of lower jaw from angle to symphysis	... 0·55
" " molars	... 0·24

The interparietal is generally more or less pentagonal, the lateral extremities being usually truncated, though occasionally angulate or sub-angulate. The posterior edge is usually nearly straight, sometimes convex, the two anterior edges very little concave, and the anterior angle very slightly projecting. The nasals diminish regularly in breadth behind.

Besides the original examples from Moupin and Western Sechuen, specimens have been sent to the Paris Museum from the western part of the province of Fokien, the South-western China.

This species is undoubtedly very close to *A. sikimensis*, from which it is only distinguished by its shorter ears and feet, the characters of the teeth not being sufficiently constant to serve as a satisfactory distinction. It is far from improbable that intermediate forms may exist in the Bhutan and the other Eastern Himalayan tracts intervening between Sikkim and Moupin.

The following Indian and Himalayan rats and mice have been incorrectly referred to the genus *Arvicola* :—

Arvicola indica, Gray and Hardwicke, Illustrations of Indian Zoology, I, pl. 11; = *Mus (Nesokia) hardwickii*.

Arvicola bengalensis, Gray and Hardwicke, Illustrations of Indian Zoology, II, pl. 21; = *Mus (Nesokia) bengalensis*, [= *Nesokia indica*, Blyth and Jerdon; *Mus (Nesokia) blythianus*, Anderson.]

“*Arvicola? Neotoma*, two sp n., *pyctorhis* and *myothrix*, nob.,” Hodgson, J. A. S. B., 1841, X, p. 915.

“*Arvicola? myothrix*, Hodgson,” Horsfield, P. Z. S., 1856, p. 401.

These are the species very imperfectly described by Hodgson (Ann. & Mag. Nat. Hist. 1845, XV, p. 267) as *Mus? pyctorhis* and *Mus? myothrix*. The former proves, on an examination of the type in the British Museum by Mr. Thomas, to have been founded on an aberrant individual of the common house and tree-rat of India (*Mus rufescens* auctt.), and belongs to the form called *Mus æquicaudalis* by Hodgson. The type of *Mus myothrix* is a skin without any skull; but I have no hesitation in identifying it with *Golunda ellioti*, to which an affinity was suggested by Jerdon ('Mammals of India,' p. 214).

“*Arvicola? hydrophilus*, Hodgson,” Gray, List of the Specimens of Mammalia in the British Museum, 1843, p. 119.

This is *Mus? hydrophilus*, Hodgson, Ann. & Mag. Nat. Hist. 1845, XV, p. 267. No original type can be found, and it is quite uncertain what the species is. Mr. Thomas has endeavoured to identify it, but in vain. The figure in Hodgson's drawings shows a large mouse or small rat with a pure white belly, and might well be taken from a young individual of the common white-bellied Himalayan rat, *Mus nitidus* (= *Mus rufescens*, var.), or of *Mus jerdoni* (*Leggada jerdoni*, Blyth: this species is not a true *Leggada*).

NOTE.—The teeth figured in the accompanying plates are those of the right upper and right lower jaw, the anterior extremity uppermost, and the upper jaw teeth above the lower. It results from this arrangement that in the upper figures (upper teeth) the outer or external angles are to the left, the inner to the right; whilst in the lower figures (lower jaw) the reverse is the case, the outer side of the jaw being to the right, the inner to the left. All the figures are enlarged 8 diameters.